ECOLOGY
Pre-AP Seventh Grade Science
2011-2012

Description

Ecology is the scientific study of interactions of organisms with one another and with the physical (abiotic or nonliving) environment. It includes the study of environmental problems such as pollution, and involves research on the natural world from many viewpoints. Experiments, both in laboratory and in field settings, are a critical part of the study of ecology. Some experiments focus on populations of a single species, or on the interactions of populations within a community. Other experiments focus on the movement of matter and energy through an ecosystem. Experiments might also center on large scale processes within a biome, or on global patterns within the biosphere such as the greenhouse effect and global warming. Natural processes also affect Earth's ecosystems. Floods, hurricanes, tornadoes, earthquakes and volcanoes may all have devastating effects on local and regional ecosystems. Humans can have a negative impact on ecosystems through acts such as overhunting or polluting. However, through the process of succession, ecosystems may rebuild themselves after such natural or anthropogenic disasters. Another factor threatening the health of Earth's ecosystems is the introduction of invasive species. Invasive species are harmful, non-native plants, animals, and microorganisms that are introduced into an environment in which they did not evolve. With few or no natural enemies to limit their reproduction and spread, they can endanger ecosystems and the organisms within it. Ecology also means studying biodiversity. Biodiversity encompasses all the plant and animal species in a specified area which are dependent upon each other for survival. Biodiversity is what perpetually sustains an ecosystem. Sustainability means to live in such a way that current needs are met while at the same time resources for future generations are preserved. While sustainability relates to topics other than ecology, a healthy environment is the basis for a healthy society. Emphasis in this unit is placed on experimental design and the study of organisms in their natural environments, as well as on human actions that endanger the health of our planet.

Connections

Ecology is the study of relations and interactions between organisms and their environment, including both biotic (living) factors and abiotic (nonliving) factors, as well as the impact of human action. In a previous unit, adaptations and natural selection were explored; both processes are clearly the result of an organism's interaction with its environment, even when that interaction occurs over many generations. The transformation of energy within an ecosystem was also covered in a previous unit with an examination of energy pyramids and food webs. Changing one factor in a food web affects all other organisms that are part of that food web, much like changing biotic or abiotic factors in an ecosystem affects all other components of the ecosystem.

Enduring Understandings

1. Ecology is the study of organisms and their interaction with all of the biotic and abiotic factors in an ecosystem. Scientists learn about ecology through experimentation and observations of organisms in the natural habitats. Only by observing organisms in their environment can scientists learn how to effectively protect our Earth and its resources, both biotic and abiotic, while at the same time providing materials essential for survival.
2. Some abiotic factors in an ecosystem are shaped by the processes of weathering, erosion and deposition. These processes are necessary features of environmental succession.
3. Without the greenhouse effect, the Earth would not be warm enough for humans to live. The greenhouse effect makes the Earth warmer by trapping energy in the atmosphere due to

certain gases in the atmosphere like water vapor, carbon dioxide, nitrous oxide, and methane. Without these gases, heat would escape back into space and Earth's average temperature would be about 60ºF colder. But if the greenhouse effect becomes too strong, it could make the Earth warm enough to cause problems for living organisms.

4. Warming of the Earth may lead to changes in rainfall patterns or a rise in sea level due to the melting of polar ices.
5. Climate is the long-term average of a region's weather events. Climate change represents a change in these long-term weather patterns.
6. Global warming refers to a climate change in which there is an average increase in the Earth's temperature. Periods of increased heat from the sun may have helped make the Earth warmer, but many scientists also attribute warmer temperatures to the greenhouse gases produced by people.
7. Biodiversity encompasses all the plant and animal species in a specified area which are dependent upon each other for survival. These organisms help provide for basic human needs such as food, shelter, and medicine. Biodiversity enables ecosystems to put oxygen in the air, enrich the soil, purify the water, protect against flood and storm damage and regulate climate.
8. Growing consumption of resources and increasing populations have led to a rapid loss of biodiversity, making it more difficult of Earth's natural systems to provide resources necessary for survival.
9. Human actions are the primary means of introduction of invasive species. These invaders are the second- largest threat to worldwide biodiversity after habitat loss. Gypsy moths, kudzu, and zebra mussels, are all examples of invasive species that have pushed out native species.
10. Living organisms are dependent on each other for survival. They are also dependent on stable abiotic conditions. If any biotic or abiotic factor changes, there are ramifications throughout the ecosystem.
11. Natural disasters like floods, forest fires, hurricanes and tornadoes may damage ecosystems.
12. Human actions such as overhunting, overbuilding, or over-fertilizing impact both biotic factors, as when habitats are destroyed thereby causing relocation or extinction of species; and abiotic factors, as when human waste is responsible for contamination of groundwater.
13. Damaged ecosystems can repair themselves through a process called succession. Depending on the state of the ecosystem, succession may occur over a short period of time or over eons. Primary succession begins in where there is no soil, such as an area covered by a lava flow; secondary succession may begin in area devastated by flood or fire, but where soil is still present.
14. Biodiversity is essential for survival. Genetic variation, variety of species, and variety of biomes, are all ways that biodiversity is ensured on Earth.
15. Human populations are increasing rapidly, and are in danger of outstripping the earth's ability to supply necessary resources. Sustainability means to live in such a way that current needs are met while at the same time resources for future generations are preserved. One way to help ensure sustainability is by increasing conservation efforts.

Essential Questions

1. What is ecology?
2. What are weathering, erosion, and deposition, and how are they related?
3. What is the greenhouse effect?
4. What are the benefits of a normal greenhouse effect, and what are the consequences of a growing greenhouse effect?
5. What is the difference between climate and weather?
6. How is climate related to global warming?
7. What are the potential consequences of global warming?

8. How are human population trends related to excavation, transport, and use of natural resources?
9. What is the potential impact of introducing invasive species into an area?
10. What is biodiversity and what is its relationship to survival of a species?
11. How have humans impacted our environment and what long-term effects are there?
12. How do ecosystems recover from interference either by natural or anthropogenic processes?
13. What is sustainability and how can it be achieved?
14. How are biodiversity and sustainability related?

Essential Concepts and Skills

By the end of the unit, the student is expected to:

1. Simulate the processes of weathering, erosion and deposition
2. Relate weathering, erosion, and deposition to natural disasters such as floods, hurricanes, forest fires, tornadoes, and tsunamis
3. Model the process of leaching within a groundwater system
4. Calculate range, central tendency, and sampling error for data collected about different types of organisms in an ecosystem
5. Evaluate the biodiversity of an ecosystem based on range, central tendency, and sampling error
6. Map the potential ramifications of human impact on the environment
7. Graphically represent trends that suggest an increase in greenhouse gasses is resulting in global warming
8. Predict the impact of growing populations on the extraction, transport, and usage of natural resources like coal or water
9. Plan an investigation, including procedure, observations, data gathering, calculations, and analysis, to trace the changes in a specific population in an ecosystem over time
10. Infer the relationship between a population's size and the environment in which it lives
11. Illustrate the biodiversity in the flora and fauna of different biomes on Earth
12. Deduce characteristics an organism needs in order to survive in different biomes on Earth
13. Identify the abiotic features of different biomes on Earth that are necessary to support the species that live there
14. Compare and contrast primary and secondary succession
15. Justify or refute the claim that human contributions to greenhouse gasses are causing Earth's temperature to rise
16. Describe how biodiversity contributes to sustainability

What do students typically have as misconceptions?

1. Biodiversity relates to only animals.
2. Global temperatures are rising at a rapid, unprecedented rate.
3. Carbon dioxide is the most common greenhouse gas.
4. Carbon dioxide is a pollutant.
5. Global warming and the greenhouse effect are the same thing.
6. The greenhouse effect is caused when gases in the atmosphere behave as a blanket and trap radiation.
7. The greenhouse effect is bad and will eventually cause all living things to die.

Preconception Survey

1. Describe the greenhouse effect?
2. What would happen if Earth's atmosphere no longer created the greenhouse effect?
3. Describe global warming.

4. Are global warming and the greenhouse effect related? Explain.

Formative Assessment Items

1. Model weathering, erosion, and deposition using a stream table.
2. Demonstrate how water infiltration can carry pollutants underground
3. Simulate population density sampling using the quadrant method
4. Simulate population density using core samples
5. Place succession photos into sequential order and explain the rationale of the chosen order
6. Find and graph data on the flora and fauna of different biomes, then rank each biome in terms of diversity and explain why the rankings are believed to be correct
7. Design a lab to observe population changes in brine shrimp over time due to differences in abiotic conditions
8. Following an invasive species web quest, conduct a Socratic circle discussion to determine consequences of introducing an invasive species the effectiveness of current prevention policies
9. Critique a lab on the greenhouse effect as to the misconceptions it promotes, then redesign the lab so to be more accurate

TEKS Covered

7.8 Earth and space. The student knows that natural events and human activity can impact Earth systems. The student is expected to:

A) predict and describe how different types of catastrophic events impact ecosystems such as floods, hurricanes, or tornadoes.

B) analyze the effects of weathering, erosion, and deposition on the environment in ecoregions of Texas.

C) model the effects of human activity on groundwater and surface water in a watershed. ***Supporting Standard-Category 3***

7.10 Organisms and environments. The student knows that there is a relationship between organisms and the environment. The student is expected to:

A) observe and describe how different environments, including microhabitats in schoolyards and biomes, support different varieties of organisms.

B) describe how biodiversity contributes to the sustainability of an ecosystem. ***Supporting Standard-Category 4***

C) observe, record, and describe the role of ecological succession such as in a microhabitat of a garden with weeds. ***Supporting Standard-Category 4***

College Board Standards Covered

LSM-PE.3.1.2 Give examples of instances when specific organisms impact their local environment, and describe how other organisms are affected by the environmental change.

LSM-PE.3.1.6 Investigate the relationship (s) between a population of organisms and the physical (abiotic) factors of an environment.

*[**BOUNDARY:** The preferred method of conducting an investigation for this concept is participation in a field experience; however, a lab-based experience is appropriate when investigating certain organisms (e.g., algae, duckweed, fruit flies, insects, fungi, bacteria). The physical (abiotic) factors used in the lab can be those that are introduced into the environment as a result of human activity. Any investigation conducted should not purposely intend to harm or kill the organisms.]*

LSM-PE.3.1.6a Formulate a scientific question that addresses the relationship between the number of organisms in a population and the physical (abiotic) factors of their environment.

LSM-PE.3.1.6b Plan an investigation of the relationship between the number of organisms in a population and a single variable of their environment. Investigation could include random sampling (e.g., measurements at different times or locations) of the population size within the ecosystem and, when possible, controlling other relevant variables (e.g., time of day, time of year).

LSM-PE.3.1.6c Gather and record data on the number of organisms, the environmental variable that is being investigated and other variables that could impact the conclusion about the relationship between environmental factors and population size.

LSM-PE.3.1.6d Organize the data (e.g., using a data table) in order to demonstrate the relationship, if any, between environmental factors and population size.

LSM-PE.3.1.6e Calculate the mean size of the population at different locations in the ecosystem or at different times, and rate of change of population size. Make a claim about the relationship between population size and each environmental factor investigated.

LSM-PE.3.1.7 Construct representations, using data and information gathered from print and electronic resources, of the different physical (abiotic) conditions that exist on Earth and the diverse environments (biomes) that arise from these varying physical (abiotic) conditions. Collect and organize data on the number and types of organisms (plant and animal) that exist in these diverse environments, and find patterns between the number and types of organisms based on physical (abiotic) conditions.

LSM-PE.3.1.8 Analyze the characteristics of different species (both plant and animal) within the same environment. Based on this analysis, identify the characteristics that allow them to successfully survive in that environment.

LSM-PE.3.2.7 Give examples, using information gathered from print and electronic resources, of invasive species in a particular environment. Explain, using information about the needs and behaviors of the invasive species, why invasive species are often able to increase rapidly and why the numbers of other organisms either increase or decrease when invasive species enter an ecosystem.

LSM-PE.3.3.1 Investigate the biodiversity of two or more ecosystems and/or two or more areas of an ecosystem.

LSM-PE.3.3.1a Make observations and gather data on the number of different kinds of organisms and the total number of organisms in the different ecosystems or in the areas of the ecosystem.

LSM-PE.3.3.1b Re-express and organize data in a graph that represents the number and kinds of species.

LSM-PE.3.3.1c Calculate measures of central tendencies (i.e., mean, mode), spread of data (i.e., range) and sampling error for the number of different kinds of organisms and the total number of organisms in the different ecosystems or in the areas of the ecosystem. Analyze data, and make a claim, based on the data collected, as to which area of the ecosystem is more biodiverse.

LSM-PE.3.3.2 Predict and justify, based on knowledge of interaction between organisms and their physical (abiotic) environment, what might happen to the number of organisms of a given species in an ecosystem following a temporary biological (biotic) or physical (abiotic) change in that ecosystem (e.g., a very cold winter or a disease that kills large numbers of one of the species in the ecosystem).

LSM-PE.3.3.3 Give examples, using information gathered from print and electronic resources, of human-induced disruptions to an ecosystem that can affect the composition of that ecosystem. Explain, using evidence of the relationships among different organisms and using knowledge of the interaction of organisms with the physical (abiotic) environment, why one disruption can impact the composition of the ecosystem.

ESM-PE.1.1.1 Observe and explain, using observable features in the environment, the dominant physical weathering and erosional processes that take place in a given location.

ESM-PE.5.1.1 Analyze a graphical representation of population data to make claims concerning temporal trends in the population.

ESM-PE.5.1.2 Make claims about the relationship between population demographics and resource use. Claims are based on demographic, economic and resource-use data for different countries.

ESM-PE.5.1.3 Construct a representation that illustrates the benefits and consequences of humans' use. Claims are of a specific resource, and identify both the impacts that can result from the extraction, transport and use of the resources, as well as the systems on Earth that are affected by these human activities.

ESM-PE.5.2.1 Identify locally important natural hazards, and predict the impacts of these hazards on humans.

ESM-PE.5.2.2 Use a geologic map of the world to predict areas that are at risk due to geologic hazards such as earthquakes, volcanoes and tsunamis.

ESM-PE.5.3.1 Construct a representation that illustrates the impact of human activities on climate and the impact of climate on natural and anthropogenic systems, as well as interactions that are positive or negative feedback loops.

ESM-PE.5.3.1a Evaluate uncertainties about the cause of Earth's current and ongoing climate change. Evaluate and refine **scientific questions** that could assist in appraising the relative impacts of its contributing factors.

ESM-PE.5.3.1b Justify the selection of data needed to analyze long-term trends in climate change by distinguishing between climate and weather.

ESM-PE.5.3.1c Make claims concerning the effects of anthropogenic carbon on climate change, using temporal data of atmospheric chemistry, global temperature and human activities that release key greenhouse gases and aerosols.

Vocabulary

ecology, biotic factors, abiotic factors, catastrophic events, physical weathering, chemical weathering, erosion, deposition, groundwater, surface water, watershed, recharge zone, flora, fauna, biodiversity, biome, microhabitat, ecological succession, primary succession, secondary succession, natural resources, sustainability, habitat, population, species, niche, predator, prey, food webs, food chains, limiting factor, invasive species, global warming, greenhouse effect, anthropogenic